

REMARKS

Claims 1-12 and 14-16 are pending in the present application.

At the outset, Applicants wish to thank Examiner Sheehan for the helpful and courteous discussion with their undersigned Representative on June 14, 2007. During this discussion the amendments and remarks set forth herein were discussed. Reconsideration of the remaining rejections is respectfully requested in view of the amendments and remarks set forth herein.

The rejections of: (a) Claims 1-13 under 35 U.S.C. §103(a) over Kanekiyo et al in view of Kaneko et al, and (b) Claims 1-13 under 35 U.S.C. §103(a) over Satou et al in view of Kanekiyo et al and Kaneko et al, are respectfully traversed.

The present invention is drawn, *inter alia*, to composite rare-earth anisotropic bonded magnets, comprising:

(A) Cobalt-less R1 d-HDDR coarse powder with an average grain diameter of 40-200 μm and having micro-cracks, comprising:

1. Cobalt-less R1 d-HDDR anisotropic magnet powder, obtained by performing a d-HDDR treatment on a cobalt-less R1 alloy of a rare-earth element including yttrium (Y) (hereafter, "R1"), iron (Fe), and boron (B) as the main ingredients and fundamentally not containing cobalt; and
2. #1 surfactant that coats at least one part of the grain surface of said cobalt-less R1 d-HDDR anisotropic magnet powder; and

(B) R2 fine magnet powder with an average aspect ratio of 2 or less and average grain diameter 1-10 μm , comprising:

1. R2 anisotropic magnet powder with a maximum energy product (BH)_{max} 240 kJ/m³ or more and with a rare-earth element including yttrium (hereafter, "R2") as one of the principle ingredients; and
2. #2 surfactant that coats at least one part of the grain surface of said R2 anisotropic magnet Powder and

(C) a *thermosetting* resin as binder; wherein
either:

- (i) the said bonded magnet contains 50-84 wt % of said Co-less R1 d-HDDR coarse magnet powder, 15-40 wt % of said R2 fine magnet powder, and 1-10 wt % of said thermosetting resin; and wherein relative density (ρ/ρ_{th}) of the said bonded magnet, which is the ratio of volume density (ρ) to theoretical density (ρ_{th}), is 91-99%; and wherein normalized grain count of the said Co-less R1 d-HDDR coarse magnet powder in the said bonded magnet, where per unit area apparent grain diameter is 20 μm or less, is 1.2×10^9 pieces/m² or less; the said composite rare-earth anisotropic bonded magnet having the special characteristics of outstanding magnetic properties and heat tolerance (see Claim 1); or
- (ii) the said compound contains 50-84 wt % of said Co-less R1 d-HDDR coarse magnet powder, 15-40 wt % of said R2 fine magnet powder, and 1-10 wt % of said thermosetting resin; and the said compound having a composition that direct contact between grains of the said Co-less R1 d-HDDR coarse magnet powder is avoided by enveloping the grains in said thermosetting resin, said thermosetting resin being a ferromagnetic buffer which said R2 fine magnet powder is uniformly dispersed (see Claim 7).

However, the presently invention is fundamentally different from the cited reference in the intended powder and the intended technique. First of all, the present invention is quite different from the cited references in the object to be solved. The Examiner seems to have

the following interpretation: when rare-earth magnet powders have the same composition, they are the same as a magnet powder, even if each method for producing such magnet powders is different. However, as for rare-earth magnet powders, magnetic properties (BHmax, whether anisotropic or isotropic), oxidation resistance, heat resistance (irreversible loss rate) and so on are remarkably different depending on the method for producing such magnet powders.

The cited references are based on the premise that magnet powders having low magnetic properties and excellent oxidation resistance are used. On the contrary, the present invention is based on the premise that magnet powders in which magnetic properties are very excellent and the oxidation resistance is very poor are used. The present invention and the cited references are, thus, 180° opposite from each other in this point.

To illustrate this point, the characteristics of MQP-B isotropic magnet powder shown in Kanekiyo et al, Applicants direct the Examiner's attention to the Table entitled "MQP™ Isotropic Powers" **submitted herewith** which was available from Magnequench (the maker of the MQP-B isotropic magnet powder). As seen from "Energy Product, (BH) max" of "MQP-B", (BH) max is 111 to 126kJ/m³.

On the contrary, as for Co-less R1 d-HDDR coarse powder of the present invention, (BH)max is 279.3kJ/m³ or more, which is at least about twice as MQP-B powder used in the cited reference. The oxidation resistance is apparent by comparing the irreversible loss rate of each bonded magnet as shown in the table below:

Irreversible loss rate of bonded magnet

Sample	Irreversible loss rate (%)		Remarks
	100°C	120°C	
Bonded magnet of present invention (Composite bonded magnet using d-HDDR powder)	-3.7	-6.1	Examples of present invention Sample No. 1-1
Conventional bonded magnet (Bonded magnet using d-HDDR powder)	-18.0	-29.0	Comparative example of present invention Sample No. B1
Bonded magnet of cited reference (Bonded magnet using only MQP-B powder)	-3.3	-3.8	-

-Samples 1 and 2 are the data described in the present specification. (See[0146]-[0163], Tables 1 A, 1 B, 3A and 3B.)

-Sample 3 shows irreversible loss rate of bonded magnet comprising MQP-B powder, instead of Co-less R1 d-HDDR coarse powder of Sample 2.

-Reference data (Data of powder as simple substance)

(1) Composition MQP-B powder : Nd-Fe-Co-B alloy composition (at%)
 d-HDDR powder : 12.5Nd-6.4B-0.3Ga-0.2Nb (at%)

(2) Magnetic properties

MQP-B powder : 111-126 (kJ/m³)
 d-HDDR powder : 320(kJ/m³)

In view of the foregoing, Applicants submit that the Co-less R1 d-HDDR coarse powder of the present invention is remarkably different from magnet powders produced by a melt-spun method (powder of the cited references), isotropic magnet powder or nano-composite isotropic magnet powder of MQI company.

With respect to the powder disclosed in Satou et al, Applicants submit that the ground powder of the sintered magnet used therein (paragraphs [0003]-[0008]) is quite distinct from that of the present invention. In fact this ground powder shares little, if any, similarity to the

powders of the present invention. Thus, the artisan would have no basis for comparison or expectation of success as shown in the present invention.

Further, Applicants submit that the claims are distinct from the cited art in that the cobalt-less R1 d-HDDR coarse powder of the presently claimed invention has an average grain diameter of 40-200 μm *and has micro-cracks*.

As for Co-less R1 d-HDDR coarse powder which is subjected to hydrogenation treatment in the present invention (hereinafter, merely referred as "d-HDDR powder"), no matter how the surface thereof is coated with antioxidants before molding, a new surface which is generated during molding is very easily oxidized. This is because a Nd-rich phase which is very easily oxidized exists in a grain boundary which is easy to absorb hydrogen metallurgically.

On the contrary, as for the magnet powder of Kanekiyo et al, a Nd-rich phase which is easily oxidized doesn't exist in a grain boundary which is easily oxidized, and an amorphous phase having excellent corrosion resistance exists in the grain boundary. Therefore, the magnet powder of this reference has very excellent corrosion resistance and excellent oxidation resistance originally, so it doesn't have the object as in the present invention. This is apparent from the attached Table.

Furthermore, crystal grain size of d-HDDR powder (\neq powder grain size) of the present invention is approximately 0.3 μm , but crystal grain size of powder of Kanekiyo et al which is produced by a melt-spun method is approximately 0.03 μm . Consequently, by what is called the law of Hall-Petch, the magnet powder of the cited reference has excellent strength, and it is hardly cracked originally. In addition, oxidation progresses in unit of crystal grain. So, the smaller the crystal grain is, the smaller the oxidized range is, thereby showing excellent oxidation resistance.

Therefore, d-HDDR powder which is subjected to hydrogenation treatment of the present invention is very easily cracked originally, which is caused by a method for producing the same. Furthermore, a new surface which is generated in cracking is more easily oxidized. Thus, adverse conditions are accumulated with respect to oxidation resistance.

On the other hand, the magnet powder of Kanekiyo et al is hardly cracked originally in view of the strength, which is caused by a method for producing the same. Even if the magnet powder is cracked, a new surface which is generated in cracking is hardly oxidized in view of composition and structure.

As above mentioned, it has been conventionally considered as almost meaningless that d-HDDR powder is merely coated with antioxidants. On the other hand, even if the magnet powder of Kanekiyo et al is coated with antioxidants, this only aims to prevent direct oxidization of grains in itself. This doesn't aim to prevent fundamental oxidization by means of prevention of cracks as in the present invention.

Thus, the present invention is fundamentally different from Kanekiyo et al in point of the intended powder, an object to be solved, the intended technique and the like. The same is true with the disclosure of Satou et al, which is again submitted to be fundamentally and structurally distinct from the claimed invention. Notably Kaneko et al fails to compensate for the foregoing deficiencies and thus the presently claimed invention is not obvious in view of any combination of Kanekiyo et al, Satou et al, and Kaneko et al.

The claimed invention is distinct from the cited combination of references for yet another reason. In the presently claimed invention the resin (component (C)) is a thermosetting resin.

Kaneko et al is cited as disclosing the resin. However, the resin used in Kaneko et al is a thermoplastic resin having excellent fluidity. Therefore, in Kaneko et al, first of all, it is

unnecessary to use a surfactant for the purpose of providing the fluidity. Nevertheless, Kaneko et al uses a surfactant only for preventing direct oxidization of magnet powder grains in itself, not for providing the fluidity by means of a surfactant.

So, it is impossible to achieve the idea of the presently claimed invention, namely, to use a surfactant for the purpose of promoting the fluidity, based on Kaneko et al. If a surfactant is used in Co-less R1 d-HDDR coarse powder of the presently claimed invention for the purpose of merely preventing the oxidation as in Kaneko et al, the effect for preventing the oxidation by means of a surfactant is hardly expected. The reason of this is as follows: Co-less R1 d-HDDR coarse powder of the present invention has high susceptibility to fracturing, and a new surface which is very easily oxidized generates when the powder cracks. So, even if only the grain surface is coated before cracking, this is substantially meaningless.

Therefore, in the presently claimed invention, on the presumption that a thermosetting resin having remarkably poor fluidity with respect to a thermoplastic resin is used, a surfactant is used in order to promote the fluidity of Co-less R1 d-HDDR coarse powder and to suppress cracks thereof. This is not apparent from Kaneko et al and, thus, the presently claimed invention is not obvious in view of any combination of Kanekiyo et al, Satou et al, and Kaneko et al.

In view of the foregoing, Applicants submit that even if the skilled artisan had each of Kanekiyo et al, Kaneko et al, and Satou et al in hand, the present invention would not be obvious.

As such, Applicants request withdrawal of these grounds of rejection.

The objection to the Amendment filed December 18, 2006 under 35 U.S.C. §132(a) as introducing new matter is respectfully traversed.

Applicants submit that the amendment to Chart 3A to correct the average grain diameter in Sample D1 from 45 μm to 35 μm is an obvious typographical error and the solution itself is obvious. Applicants submit that evidence for this lies in that the skilled artisan could reproduce the experiments described in the Examples supporting Chart 3A at each of 45 μm and 35 μm to see at which average grain size the remaining results are obtained. Further, Applicants submit that this correction does not affect the claims with respect to written description and/or enablement and, therefore, should be allowed entry.

Withdrawal of this ground of objection is requested.

Finally, Applicants respectfully submit that the obviousness-type double patenting rejection of Claims 1-12 over Claims 1-15 of US 10/509,687 is obviated by the abandonment of US 10/509,687 by failure to respond to the Office Action mailed September 20, 2006. Therefore, withdrawal of this ground of rejection is requested.

Applicants submit that the present application is in condition for allowance. Early notification to this effect is respectfully requested.

Respectfully submitted,
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MQP™ Isotropic Powders

Characteristic	Part No.	Magnequench										Anneal Schedule Powder
		MQP-A (13-15)	MQP-B (15-16)	MQP-C (15-16)	MQP-D (15-16)	MQP-E (15-16)	MQP-F (15-16)	MQP-G (15-16)	MQP-H (15-16)	MQP-I (15-16)	MQP-J (15-16)	
Residual Induction, B_r	mT (G)	780-820 (7.8-8.2)	850-890 (8.5-8.9)	880-920 (8.8-9.2)	880-920 (8.8-9.2)	880-920 (8.8-9.2)	880-920 (8.8-9.2)	880-920 (8.8-9.2)	880-920 (8.8-9.2)	880-920 (8.8-9.2)	880-920 (8.8-9.2)	MQP-S-11-B (10.0-11.5)
Energy Product, $(BH)_{max}$	J/m ³ (MGOe)	97-111 (12.2-14.0)	111-126 (14.0-15.6)	118-126 (14.8-15.5)	118-126 (14.8-15.5)	118-126 (14.8-15.5)	118-126 (14.8-15.5)	118-126 (14.8-15.5)	118-126 (14.8-15.5)	118-126 (14.8-15.5)	118-126 (14.8-15.5)	89-92 (10.0-11.5)
Intrinsic Coercivity, H_{ci}	kA/m (kOe)	1030-1350 (13.0-17.0)	640-800 (8.0-10.0)	720-900 (9.0-11.0)	720-900 (9.0-11.0)	720-900 (9.0-11.0)	720-900 (9.0-11.0)	720-900 (9.0-11.0)	720-900 (9.0-11.0)	720-900 (9.0-11.0)	720-900 (9.0-11.0)	670-750 (8.4-9.4)
Coercive Force, H_c	kA/m (kOe)	515 (6.4)	540 (6.8)	570 (7.1)	570 (7.1)	570 (7.1)	570 (7.1)	570 (7.1)	570 (7.1)	570 (7.1)	570 (7.1)	440 (5.5)
Magnetizing Field to >95% H_m (kA/m)	kA/m (kOe)	>2000 (25)	>1600 (20)	>1600 (20)	>1600 (20)	>1600 (20)	>1600 (20)	>1600 (20)	>1600 (20)	>1600 (20)	>1600 (20)	>1600 (20)
Temperature Coefficient of B_r	%/°C	-0.12	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11	-0.13
Temperature Coefficient of H_{ci}	%/°C	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Curie Temperature, T_c	°C	305	350	330	330	330	330	330	330	330	330	320
Maximum Operating Temperature	°C	120-160	120-160	120-160	120-160	120-160	120-160	120-160	120-160	120-160	120-160	140-180
Maximum Process Temperature	°C	200	200	250	250	250	250	250	250	250	250	350
Density, g/cc	g/cc	7.60	7.64	7.63	7.63	7.63	7.63	7.63	7.63	7.63	7.63	7.43
Particle Size Distribution		Total >40 Mesh (420 μ m) x 420 μ m opening: <0.1 vol. % Total >60 Mesh (250 μ m) x 250 μ m opening: <25 vol. % Total >270 Mesh (53 μ m) x 53 μ m opening: <12 vol. %										Total >115 μ m: <0.1 vol. % Median Size, d_{50} : 35-55 μ m Width (1 σ): 10-30 μ m

* contact Magnequench for up-to-date specifications
revised 17Sept04



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